QuanTM Architecture for Web Services

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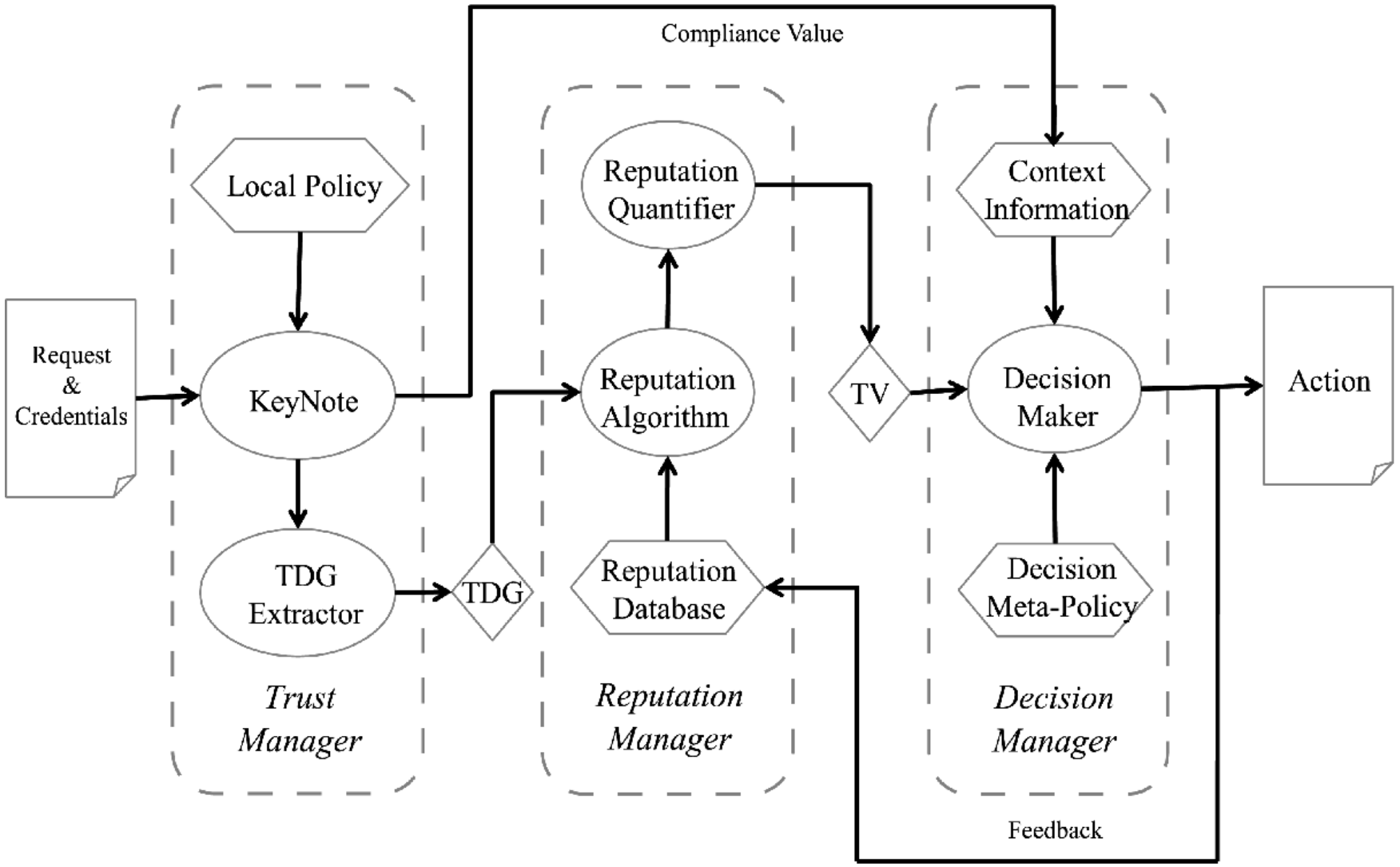
QuanTM Architecture



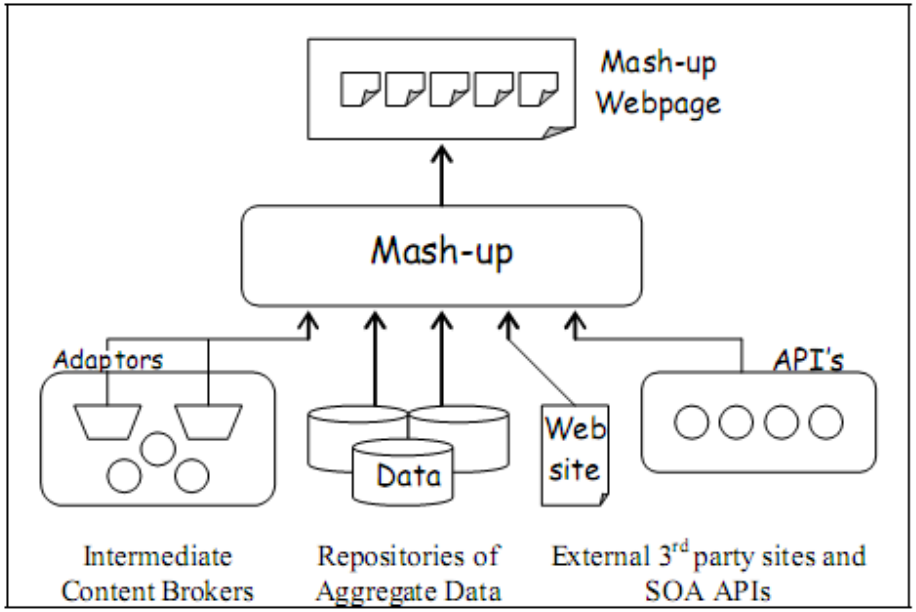
Application Area: Service Mashups

- What is Mashup:
  - Wikipedia definition
    - A mashup is a web page or application that uses or combines data or functionality from two or many more external sources to create a new service.
  - Definition from academia literature
    - A mashup is a website or web application that seamlessly combines content from more than one source into an integrated experience.

- Key aspect:
  - It involves multiple administrative/trust domains

Service Mashup

- Mashup Architecture



  - For example, the content may be drawn from local data repositories, from existing local and external web pages, accessed via SOA based APIs, and from intermediate content brokers.

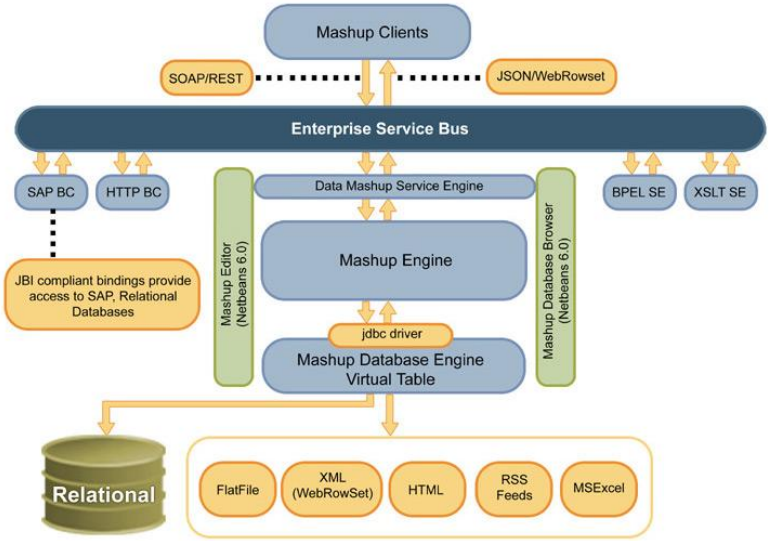
More on Mashup (cont.)

- Mashup Types:
  - Data mashups
    - combine similar types of media and information from multiple sources into a single representation
  - Consumer mashups
    - combines different data types. Generally visual elements and data from multiple sources
  - Business mashups
    - generally define applications that combine own resources, application and data, with other external web services, allowing for collaborative action among businesses and developers

Data Mashup Example

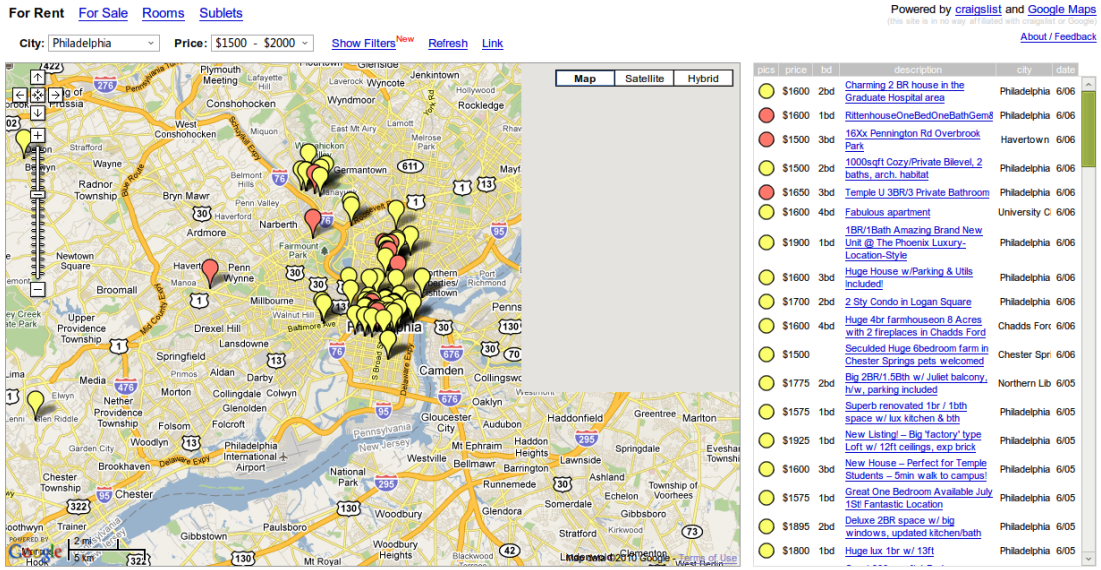
- RSS Feed
  - Integrate new post on from various blogs, websites using Google Reader
    - Integrate headline news from various news source, such as: NY-Times.com, CNN.com, and BBC.com

- Enterprise Data Mashup
  - aggregate relational datastores represented as federated query server



Client Mashup Example

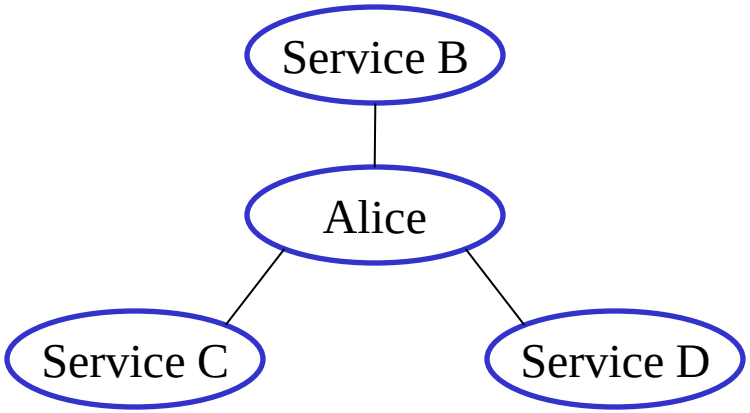
- One widely-cited example of web mashup:
  - www.housingmaps.com combines Google Maps data with Craigslist's housing data and presents an integrated view of the prices of the houses at various locations on the Google map.



Business Mashup Example

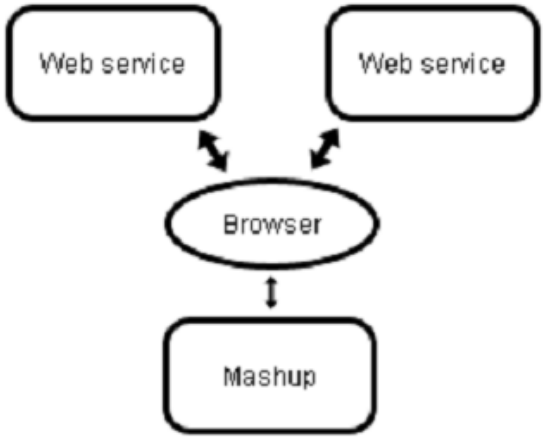
- E-trading mashup is a trading platform to allow their customers to trade globally.
- For a particular trading transaction:
  - Customer Alice initiates the trade request with Service B.
  - This is based on the pricing chart provided by Service C's charting service, with real-time price input from Service D.

Identity	Role
Alice	Trade Requestor
Service B	Trade Provider
Service C	Charting Service Provider
Service D	Real-time Price Provider



Web-based Mashup (WbM)

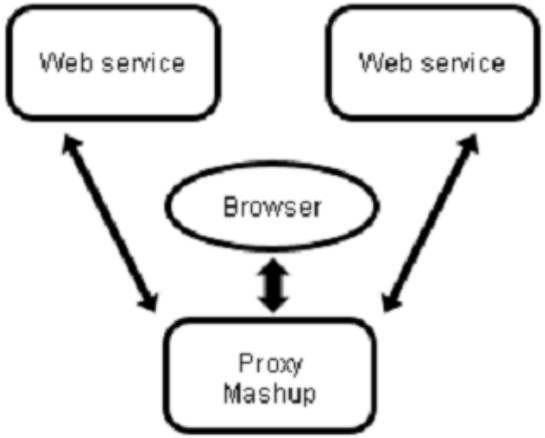
- Definition:
  - mashup typically use the user's Web browser to combine and reformat the data



- Challenges:
  - Need to transfer/share information cross multiple trust domains
- Limitations:
  - The current security model used by web browsers, the Same Origin Policy (SOP), does not support secure cross-domain communication desired by web mashup developers.
  - The developers need to choose between:
    - no trust: where no cross-site communication is allowed
    - full trust: where third-party content runs with the full privilege of the integrator (mashup provider), after explicit user consent

Server-based Mashup (SbM)

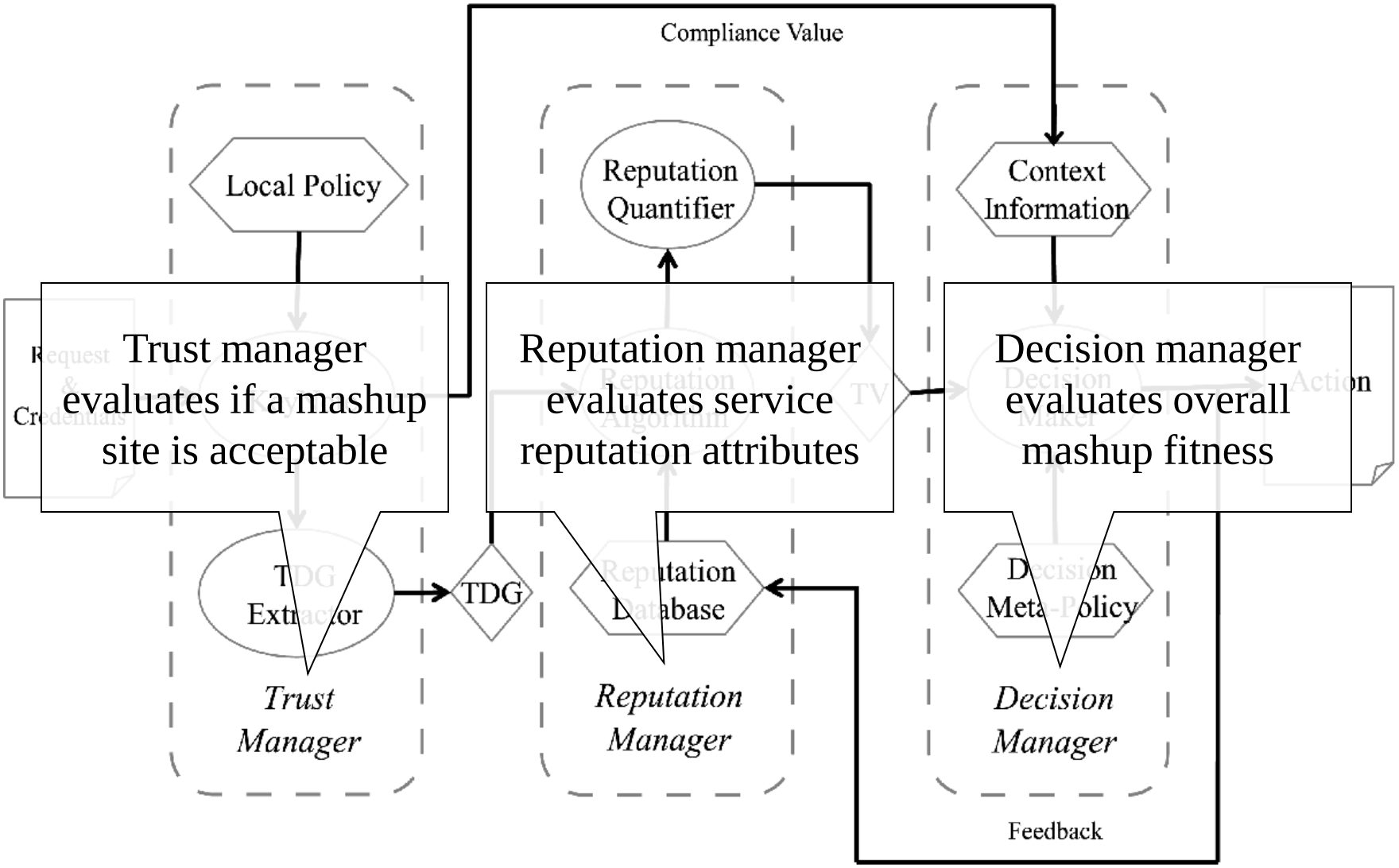
- Definition:
  - analyze and reformat the data on a remote server and transmit the data to the user's browser in its final form



- Features:
  - It does not suffer from the SOP limitation
  - Security issues can be addressed using corresponding security protocols/standards, such as: OAuth authentication technique

- Limitations:
  - Requires user to give complete trust to mashup providers on accessing his/her private data
  - Need a proxy mashup service instead of using client-side computation resource.

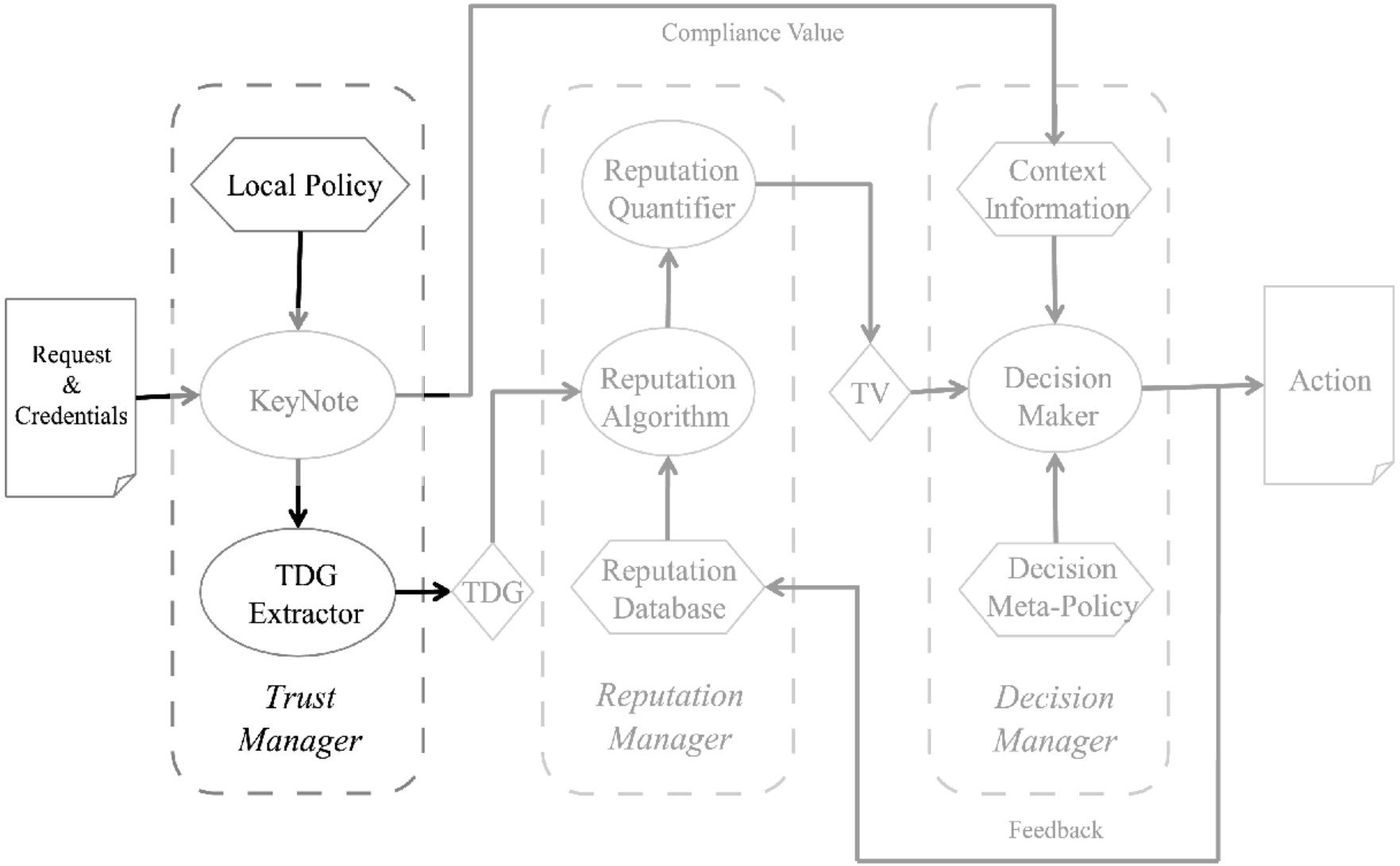
QuanTM to the rescue!



Which mashup to use/trust?

- QuanTM can be applied as a powerful trust framework, replacing current SOP
- Some mashups may be ruled out by *local policy*.
  - *E.g.*,: no mashup is allowed to execute, if:
    - some service components do not support secure connections
    - it needs third-party service to read user email contacts
- Acceptable mashup according to static local policy may have various trust-levels:
  - *E.g.*, one service component is known to leak user information to third-party violating privacy requirement
- *Decision policy* used to make the final decision
  - Different from the aforementioned local policy above

Trust Manager

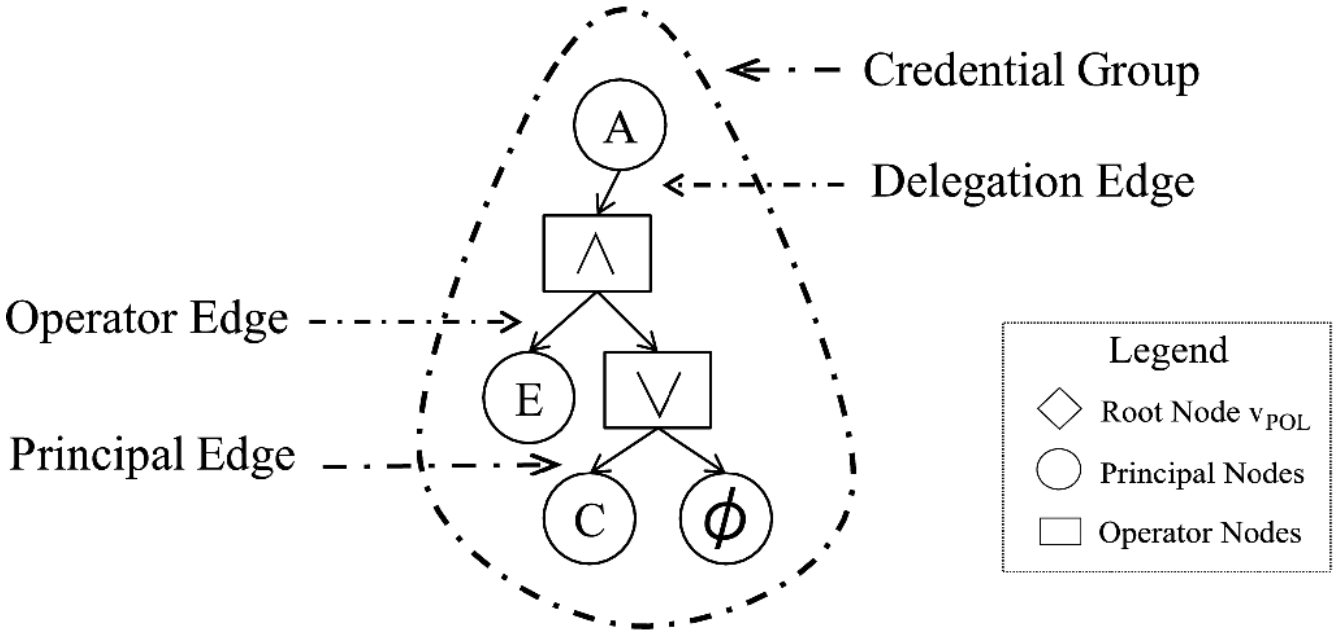


Trust Manager

- Indentify service components of mashup
  - DNS name as identifier
- Use local policy to evaluate mashup compliance
  - Qualitative value representing compliance with the policy
- Construct trust dependency graph (TDG)
  - Based on mashup dataflow and workflow
  - May require analyzing underlying javascript code

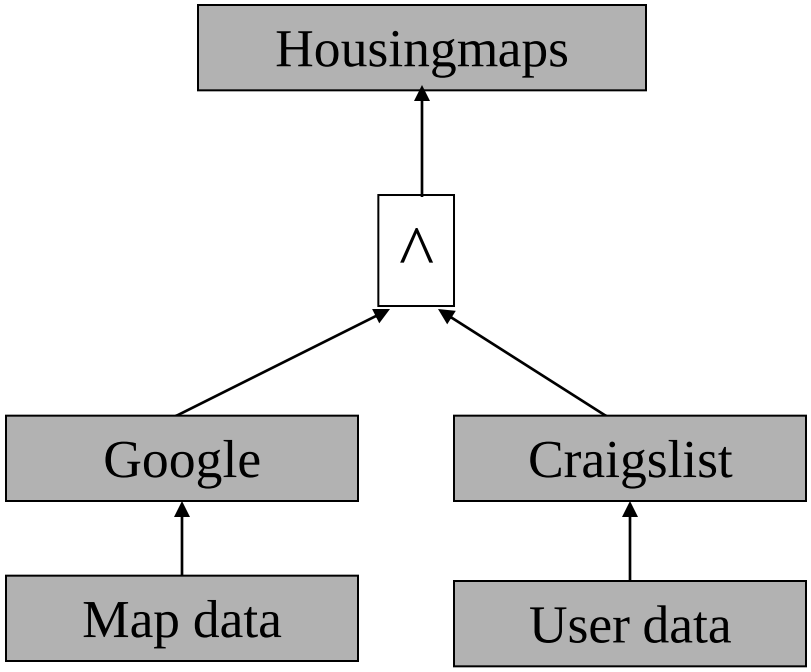
Trust Dependency Graph (TDG)

- An encoding of mashup workflow/dataflow
- Reflect trust in principals and trust relations
- Edges represent trust dependencies
- Reputations are assigned to TDG elements

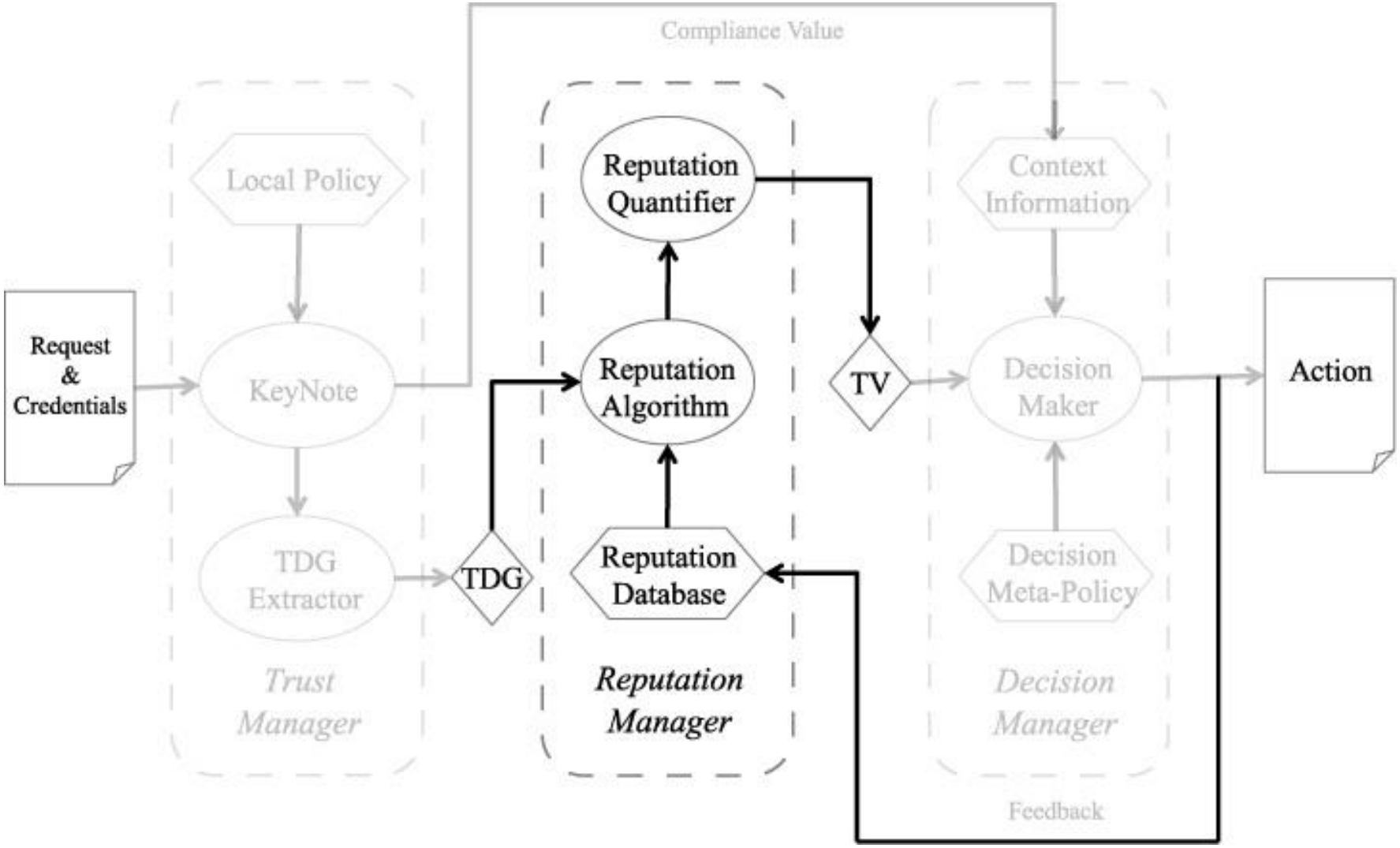


TDG for Housingmaps

- Data sources:
  - map data
  - house listings
- Services:
  - Google
    - overlay data on maps
  - Craiglslist
    - deliver user data
  - Housingmaps
    - parse and filter data from Craigslist
    - send to Google
    - arrange results



Reputation Manager



Reputation Manager

- Calculate trust value
  - Assign reputations to TDG edges using reputation values
  - “push” reputation values up the graph
- Build reputation using existing databases, e.g.,
  - General DNS reputation DB
  - Google PageRank
  - Trust-of-Web reputation DB
- Update reputation based on feedback
  - Past performance of the service
  - Experiences from other mashups and direct uses

TDG for Housingmaps with reputation

- Data sources:
  - map data
  - house listings
- Services:
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    - parse and filter data from Craigslist
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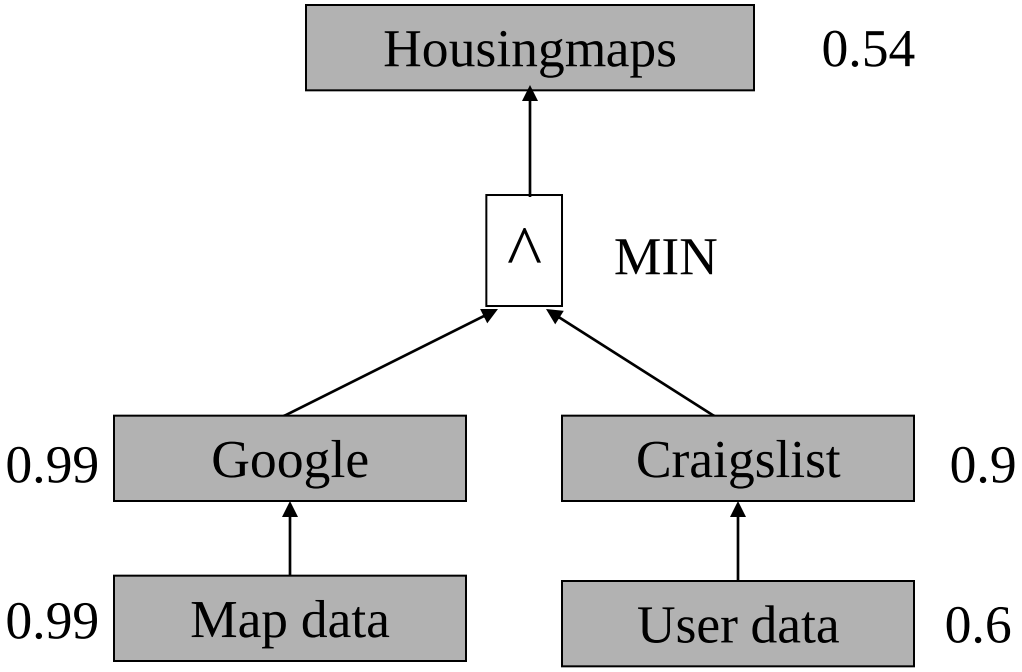
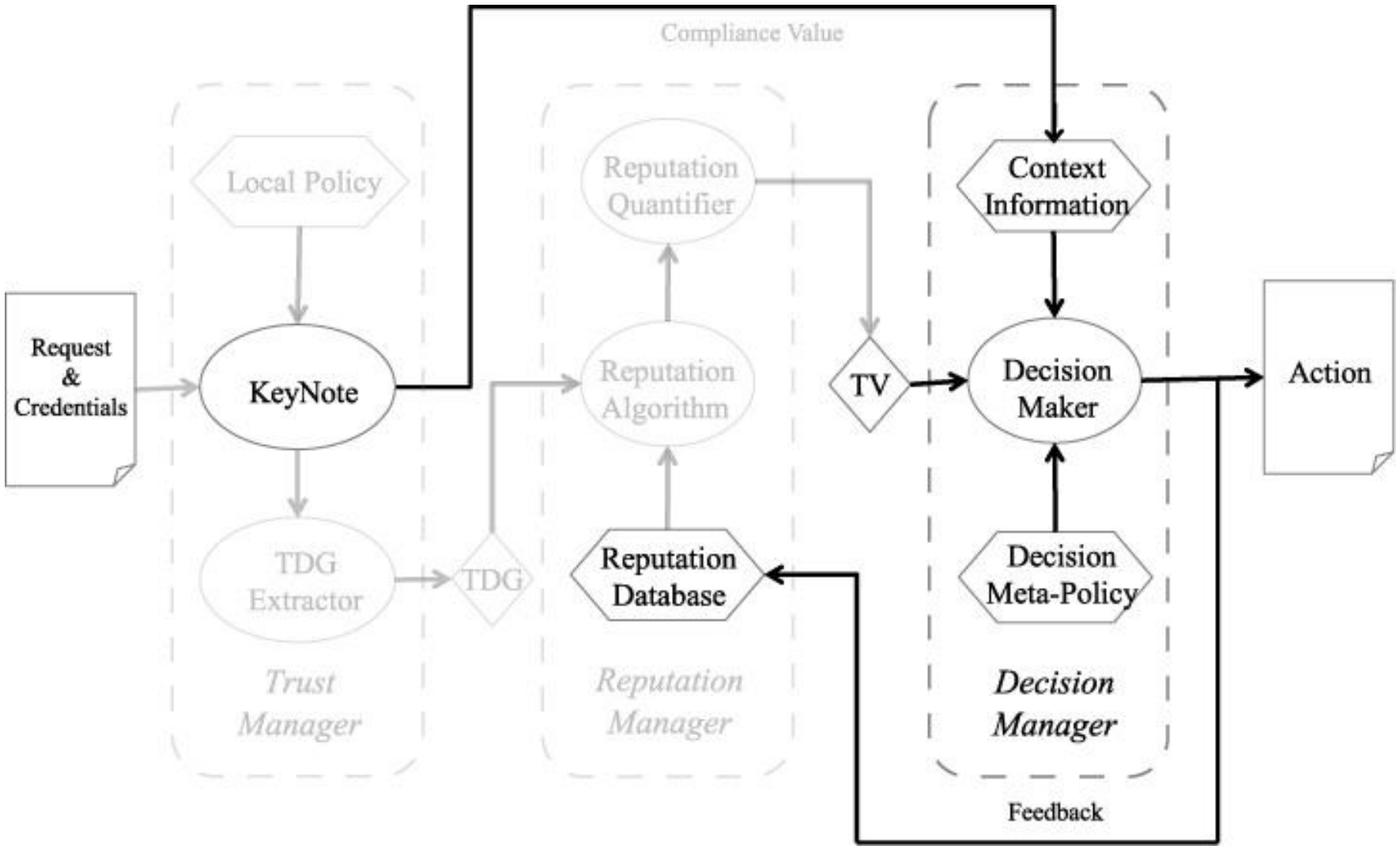


Decision Manager



Decision Manager

- Uses an user-specific meta-policy
  - Context monitors
  - Cost-benefit analysis
  - Game-theoretic formalization
- Simple example: Threshold policy
  - If CV='maybe' and TV>0.5 -> Fulfill request
  - If CV='true' always fulfill request
  - In general, thresholds can be adaptive

Current and Future Work

- Design local policy language for WbM
  - Allow user to specify their static trust requirement
- Technique to construct TDG for WbM based on code (e.g., javascript) analysis
- Integerate availble service reputaton
  - E.g., DNS reputation, PageRank, Trust-of-Web Score
- Design Decision policy language for WbM
  - Allow user to specify their dynamic trust requirement
- Implementation of QuanTM WbM as extension for real-world application (e.g., Firefox web brower)
- TDG-carrying services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Applying QTM to Mashup

- Evaluation and selection of services to use
- Differences from access control:
  - "request" is now an entry for consideration
    - Services may be evaluated initially and/or re-evaluated periodically
  - "delegation" is one service using another as part of its operation
  - "policy" describes rules for selecting and comparing services
- Similarities:
  - Trust in an entity depends on dependencies and past performance

- Issues
  - Accountability
    - Authentication (access control) and non-repudiation guarantees need to be provided.
  - Service Selection
    - Need to understand the QoS of available service components, and choose the most suitable/trustworthy ones to build mashup